Architectural Thesis

Designs

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WEIGHT

OF

STEEL ROOF TRUSSES

BY

ROBERT GRANT HOLABIRD

THESIS

FOR DEGREE OF BACHELOR OF SCIENCE
IN ARCHITECTURAL ENGINEERING

COLLEGE OF ENGINEERING
UNIVERSITY OF ILLINOIS
PRESENTED JUNE 1900

UNIVERSITY OF ILLINOIS

June 1, 1900. 190

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Robert Grant Holabird

ENTITLED Weight of Steel Roof Trusses

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF Bachelor of Science in Architectural Engineering.

N. C. Ricker.

HEAD OF DEPARTMENT OF Architecture.

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Weight of Steel Roof Trusses.

In investigating the weights of trusses for a thesis the subject has been divided into two parts, the first part being the per cent of details by weight and the weight per square foot of horizontal area covered, of trusses which have been designed and erected. The second part is devoted to a study of the Fink truss, assuming a certain load per sq. ft. for different spans, rise, and bow chord, with the object of finding out which form would give the most economical weight per sq. ft. of horizontal area covered.

Data for part one was obtained from the shop drawings of about a dozen trusses of different styles and spans. The roof coverings were obtained but the wind and snow loads for which they were designed were not. The weight of the truss was worked and then this result

UIUC

was divided by the horizontal scale
caused which gave the weight of
of these. The results showed that the
variation between the weights was very
small, they were not close enough
however to form any table which
could be used but they showed
that the designers difficulty had been
to find the weights light enough.
The results are placed in tabular form
on page 1, and drawings showing the
style on page 7.

The per cent of details of
weight in terms of the whole
machine was also obtained and
showed a variation of about one cent
but when one remembers that different
designers work widely on their methods
of obtaining details this variation does
not seem so very great. From an
average of the results the conclusion
drawn is that 5 per cent of the wt
of the main members should be
added to make up the total weight
of a truss. This is a fair and average
value and will be found to answer very

style of truss which an average
loading. The results are shown in
Table I. By means of this value
it enables me to quickly work out
the weight and cost of a truss and then
gives many valuable comments to the
designer.

In part two the analysis of
the Fink type of truss was undertaken
the first being to find out how the
unit panel load varied with the span and spacing
between centers and also to determine
the relative weights of 3 different
forms of the truss for equal spans
and spacings. Spans of 50, 75 ft, and
100 ft were assumed with trusses placed
16' centers, also 2 trusses of 50' and 75'
spans with 18' centers, but it was found
that such a small change of centers
did not affect the unit panel load.
One set of trusses had a rise of 1/5 the
span and had a horizontal lower
chord. Another set had a rise of 1/3
10' with an inclined lower chord which
had a rise of 1/5 the total rise of the

truss, the same set of trusses was designed for a Long metal Lower Chord. The trusses were designed to carry a permanent load of 5.5 lbs per sq. ft. of roof area and a live load of 20 lbs. per sq. ft. of horizontal projection. The wind load and truss weights were taken from tables in Kidder's Trusses Kirtz. Drawings showing the trusses and the data are shown on pages [illegible]

From the results we find that the wt. per sq. ft. of Long metal area covered varies directly as the span. This is shown on page [illegible] where 3 lines are plotted having the span as abscissa and the wt. in lbs. as ordinates.

We also find that the truss with a rise of 3 in 10' and a Long metal Lower Chord gives the least wt. per sq. ft. of area covered and is therefore the most economical style of truss. A truss of the same rise with an inclined Lower Chord is found to be the most extravagant. Thus we must Leave theory & go to work out the most economical

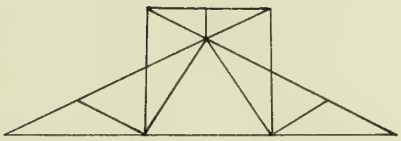
rise though it is perhaps that the truss assumed approximately its own, closely.

From the results of this test it can be seen that the field offers chances for many valuable results and if a person had time the difference between the Fink and some other style of truss would be very interesting as would also the most economical spacing of trusses which would involve not only the weight of trusses but also the shop work and erecting

TABLE I

No. of Truss.	Span.	Rise.	Wt. of Truss per. Sq. Ft. Area Covered.	Details % of Main Members.	Roof Covering.
1.	32.	9.	2.4#	19.	Slate.
2.	44.	10.	2.5	20.	" .
3.	44.	14.	2.4	13.	" .
4.	45.	10.	2.0	15.	Tile.
5.	49.	13.	3.1	20.	Slate.
6.	49.	13.	3.0	17.	" .
7.	49.	13.	2.4	18.	" .
8.	50.	12.	2.8	16.	Tile.
9.	55.	18.	2.7	19.	Gal. Iron.
10.	59.	14.	3.1	11.	Tile.
11.	70	20.	3.0	18.	Slate.
12.	75	18	3.0	13.	Tile.
13.	110	28.	5.2	11.	Slate.

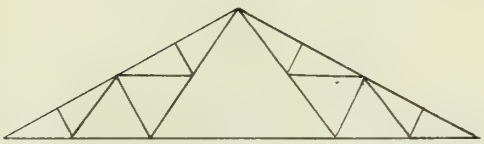
STYLE OF TRUSS FOR TABLE I.



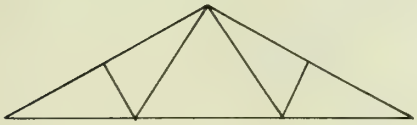
1.

2-5-6.

3.



4-9.



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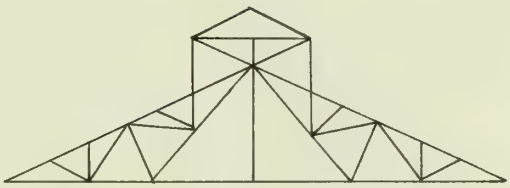

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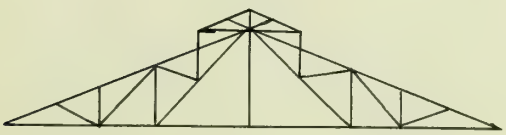

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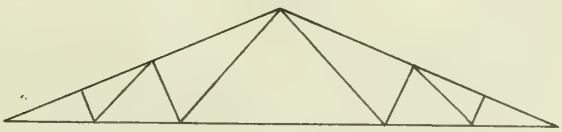

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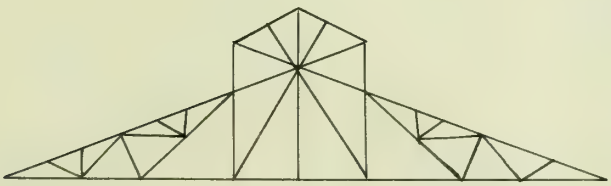

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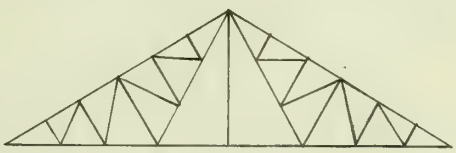
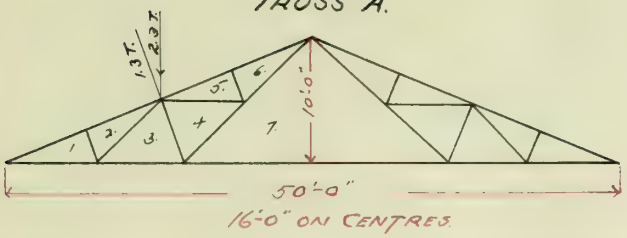


13.

TRUSS "A."

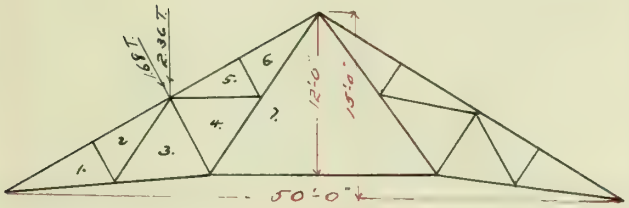


16'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	6.75	46800	4x3x11/16" ∠s	1058.0
Y1.	7.0	43900	3½x3x⅜" ∠s	437.0
Y7.	22.0	24680	3½x3x5/16" ∠s	185.0
1-2.	2.4	4600	2½x2½x¼" ∠	20.0
2-3.	7.0	6800	"	56.0
3-4.	4.8	9200	"	34.0
4-5.	7.0	6800	"	56.0
5-6.	2.4	4600	"	20.0
6-7.	7.0	20400	3x3x5/16" ∠	205.0
				2075.0
			#	310.0
				2385.0

WT. PER. SQ. FT. → 2.98 #

TRUSS "B."

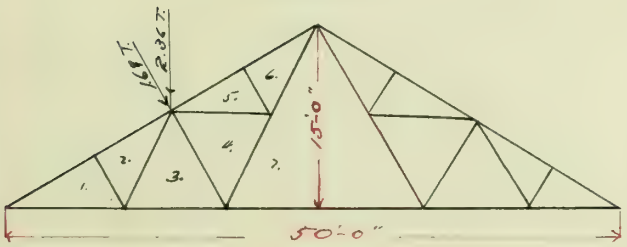


16'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT
X1.	7.3	46900	4x3x½" ∠s	1300.0
Y1.	7.8	44000	3½x3x⅜ ∠s	850.0
Y7.	20.0	24700	3½x3x5/16 ∠s	240.0
1-2.	2.6	5400.	2½x2½x¼" ∠	20.0
2-3.	7.7	8000.	"	61.0
3-4.	5.2	11000.	2½x2½x⅜ ∠	60.0
4-5.	7.7	8000.	2½x2½x¼ ∠	61.0
5-6	2.6	5400.	"	20.0
6-7.	7.8	24000.	3x3x5/16"	260.0
				2472.0
			#	370.0
				2842.0

WT. PER. SQ. FT. 3.38 #

TRUSS "C."



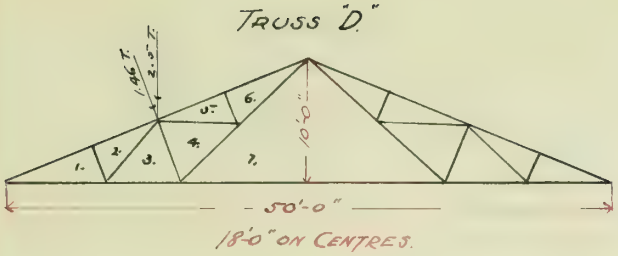
16'-0" ON CENTRES.

MEMBER	LENGTH.	STRESS	SECTION	WEIGHT
X1.	7.3	31400	3½x3½x5/16" ∠s	700.0
Y1.	8.5	25000	3x3x¼" ∠s	270.0
Y7.	16.0	15200	"	160.0
1-2.	4.5	5400	2½x2½x¼" ∠	36.0
2-3.	8.5	5000	"	68.0
3-4.	9.0	11000	2½x2½x⅜" ∠	104.0
4-5.	8.5	5000	2½x2½x¼" ∠	68.0
5-6.	4.5	5400	"	36.0
6-7.	8.5	16000	3x3x5/16" ∠	204.0
				1646.0
			#	246.0
				1892.0

WT. PER. SQ. FT. 2.37 #

NOTE → # 15% ADDED FOR DETAILS.

TRUSS "D"

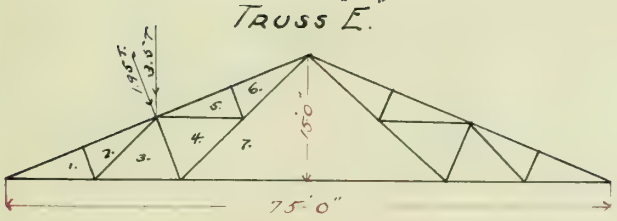


18'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION	WEIGHT.
X1.	6.75	50500	4x3x7/16" L	1058.0
Y1.	7.0	46700	4x3x3/8" L	476.0
Y7.	22.0	26000	4x3x5/16" L	312.0
1-2.	2.4	6000	2½x2½x¼" L	20.0
2-3.	7.0	8000	"	56.0
3-4.	4.8	12000	2½x2½x7/16" L	48.0
4-5.	7.0	8000	2½x2½x¼" L	56.0
5-6.	2.4	6000	"	20.0
6-7.	7.0	24000	3½x3½x5/16" L	235.0
				2271.0
			→ #	320.0
				2596.0

WT. PER SQ. FT. 2.9 #

TRUSS "E"

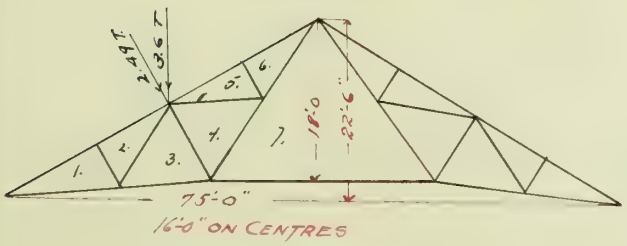


16'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS	SECTION.	WEIGHT
X1.	10.1	68000	6x3½x½" L	2473.
Y1.	11.0	62800	5x3½x5/16" L	915.
Y7.	31.0	36000	" L	645.
1-2.	4.1	8000	2½x2½x¼" L	33.
2-3.	10.5	10600	"	84.
3-4.	8.2	16000	3x3x¼" L	81.
4-5.	10.5	10600	2½x2½x¼" L	84.
5-6.	4.1	8000	"	33.
6-7.	11.0	32000	3x3x5/16" L	264.
				4612.
			# →	691.
				5303.

WT. PER. SQ. FT. 4.42 #

TRUSS "F"



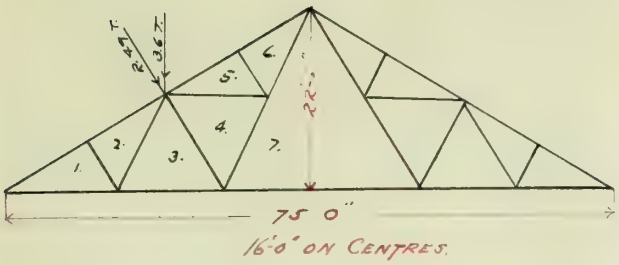
16'-0" ON CENTRES

MEMBER	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	11.1	70000	6x4x7/16" L	2550.
Y1.	12.0	63000	5x3½x3/8" L	1000.
Y7.	28.0	38000	"	582.
1-2.	4.5	8400	2½x2½x¼" L	36.
2-3.	12.0	11600	"	96.
3-4.	9.0	16800	3x3x¼" L	90.
4-5.	12.0	11600	2½x2½x¼" L	96.
5-6.	4.5	8400	"	36.
6-7.	24.0	33000	3x3x9/16" L	288.
				4774.0
			# →	716.0
				5490.0

WT. PER. SQ. FT. → 4.67 #

NOTE → # 15% ADDED FOR DETAILS.

TRUSS "G."



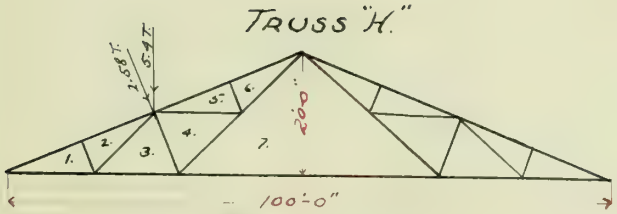
75'-0"

16'-0" ON CENTRES.

MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	11.1	45000	5x3½x⅜" L	1850.
Y1.	13.0	37500	4x3x⅜" L	840.
Y7.	23.0	22000	"	430.
1-2.	7.0	8400	2½x2½x¼" L	56.
2-3.	13.5	8000	"	108.
3-4.	14.0	16000	3½x3½x⅜" L	274.
4-5	13.5	8000	2½x2½x¼" L	108.
5-6	7.0	8400	"	56.
6-7.	13.0	22500	2½x2½x⅝" L	260.
				3982.0
				597.0
				4579.0

WT. PER SQ. FT. 3.8 #

TRUSS "H."



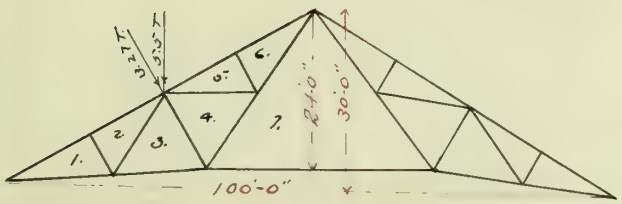
100'-0"

16'-0" ON CENTRES

MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	13.4	104000	6x4x⅝" L	3895.
Y1.	14.5	96000	6x4x½" L	1980.
Y7.	42.0	56000	6x4x⅝" L	1193.
1-2.	5.4	10400	2½x2½x¼" L	43.
2-3.	14.5	21000	3x3x¼" L	142.
3-4.	10.8	14000	" L	212.
4-5.	14.5	14000	" L	142.
5-6.	5.4	10400	2½x2½x¼" L	43.
6-7.	14.5	41500	3½x3½x⅝" L	711.
				8363.
		# →		1254.0
				9617.0

WT. PER SQ. FT. → 6.0 #

TRUSS "I."



100'-0"

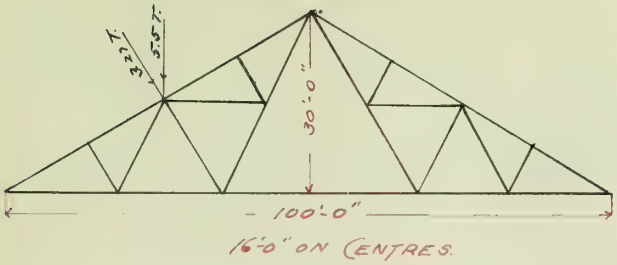
16'-0" ON CENTRES.

MEMBER	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	14.6	105000	6x6x½" L	4570.
Y1.	15.5	98000	6x4x⅜" L	1760.
Y7.	40.0	59000	" L	1130.
1-2.	5.2	11200	2½x2½x¼" L	42.
2-3.	15.4	17000	3x3x¼" L	150.
3-4.	10.4	23000	" L	203.
4-5.	15.4	17000	" L	150.
5-6.	6.2	11200	2½x2½x¼" L	42.
6-7.	15.5	51000	3x3x⅜" L	1033
				9077.0
		# →		1260.0
				10337

Note # 15% ADDED FOR DETAILS.

WT. PER SQ. FT → 6.4 #

TRUSS "J."

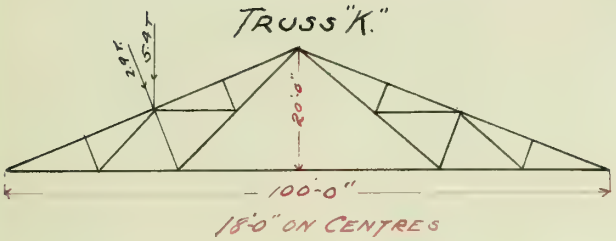


MEMBER.	LENGTH	STRESS.	SECTION.	WEIGHT.
X1.	14.6	65400	6X4X1/2" L	3910.
X1.	17.0	5100	5X3 1/2 X 3/8" L	1415.
Y7.	32.0	33000	" L	670.
1-2.	9.0	11200	3X3X1/4" L	90.
2-3.	17.0	11000	" L	170.
3-4.	18.0	23000	" L	350.
4-5.	17.0	11000	" L	170.
5-6.	9.0	11200	" L	90.
6-7.	17.0	33000	3X3X3/8"	490.

7355.0
1102.0
8457.0

WT. PER SQ. FT. 5.3 #

TRUSS "K."

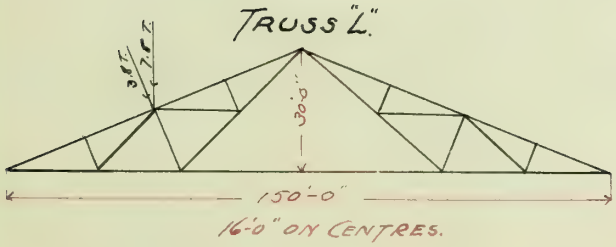


MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	13.4	106000	6X4X11/16" L	3895.
Y1.	14.5	97500	6X4X1/2" L	1980.
Y7.	42.0	56000	6X4X7/16" L	1193.
1-2.	5.4	15600	3X3X5/16" L	65.
2-3.	14.5	20200	3X3X3/8" L	208.
3-4.	10.6	31000	" L	311.
4-5.	14.5	20200	" L	208.
5-6.	5.4	15600	3X3X5/16" L	65.
6-7.	14.5	63000	3 1/2 X 3 1/2 X 1/2" L	643.

9364.0
→ # 1404.0
10768.0

WT. PER SQ. FT. 5.98 #

TRUSS "L."



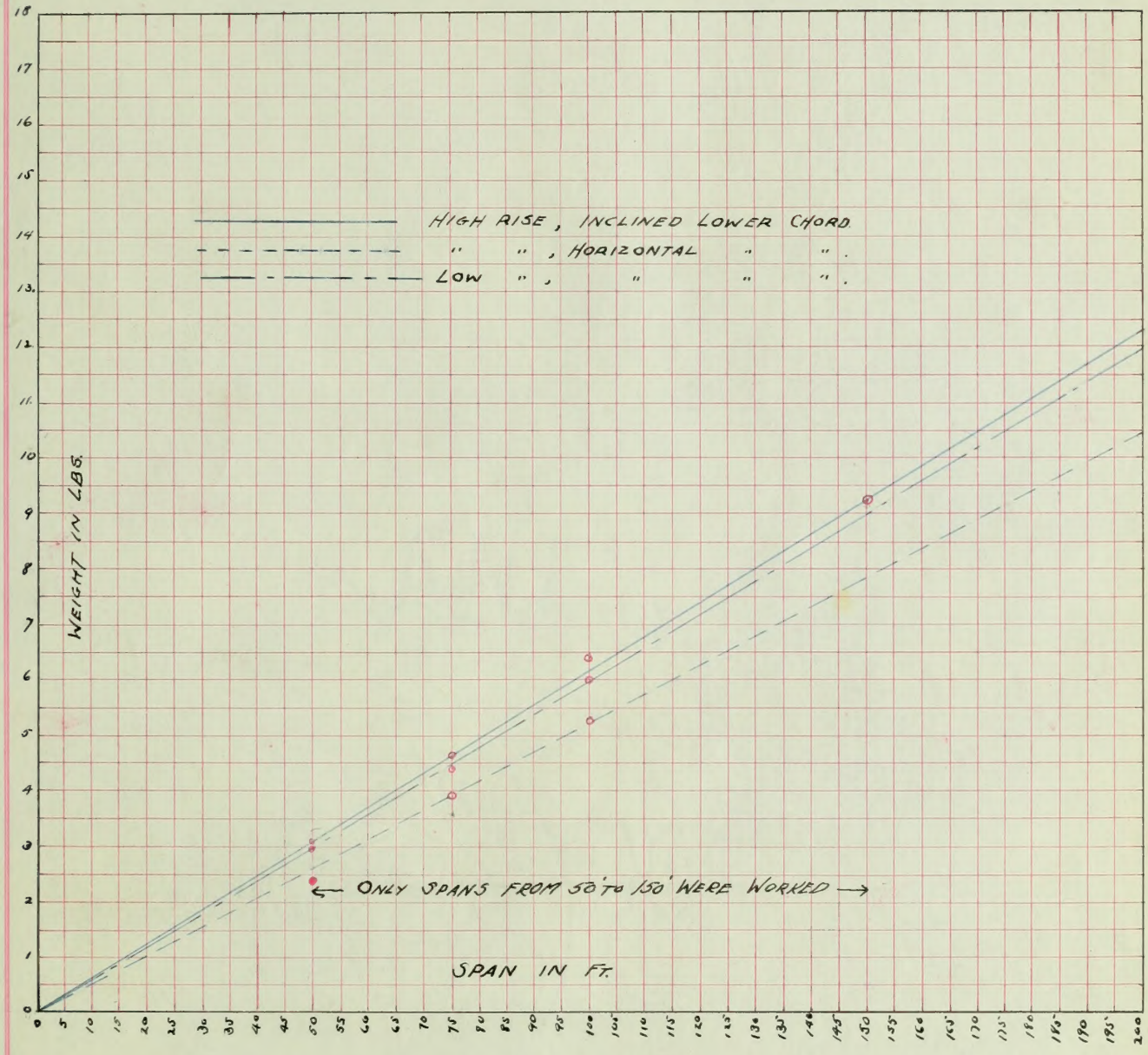
MEMBER.	LENGTH.	STRESS.	SECTION.	WEIGHT.
X1.	20.2	144800	6X6X7/8" L	10730.
Y1.	21.2	134000	6X4X11/16" L	3706.
Y7.	56.0	76000	6X4X3/8" L	1353.
1-2.	8.0	16000	3X3X3/8" L	115.
2-3.	22.0	21000	3X3X1/4" L	431.
3-4.	16.0	32000	4X4X3/8" L	621.
4-5.	22.0	21000	3X3X1/4" L	431.
5-6.	8.0	16000	3X3X3/8" L	115.
6-7.	21.2	64000	3 1/2 X 3 1/2 X 1/2" L	1887.

19389.0
2907.0
22296.0

NOTE → # 15% ADDED FOR DETAILS.

WT. PER SQ. FT. 9.27 #

LINES
SHOWING
RELATIVE WEIGHT OF TRUSSES.



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